

In Situ Reduction of Hexavalent Chromium in Deep Vadose Zone Soil

CROSS MANUFACTURING FACILITY – LEWIS, KS

WSP | Parsons Brinckerhoff

Matt Burns

David Carstens

Ademola Bakenne

Dave Rykaczewski

Remediation Services, Inc.

Butch Holum

Cross Manufacturing

Raymond Law



Presentation Outline

CROSS MANUFACTURING FACILITY – LEWIS, KS

- I. Company and Site Background
- II. Discovery of Contamination
- III. Initial Investigations
- IV. Project Partnership
- V. Pre-Design Investigations
- VI. Remedial Approach
- VII. Results



Project Background

CROSS MANUFACTURING FACILITY – LEWIS, KS



- Kansas manufacturing Co.
- Founded in 1949 by James H. Cross
- John Cross is second generation and President
- Cross' Core Values:
 1. Cross Does the Right thing
 2. Cross lives within our means; debt-free
 3. Cross is dependable



Project Background

CROSS MANUFACTURING FACILITY – LEWIS, KS

- Lewis, KS is home to the Cross Cylinder Division
- Chrome plating line decommissioned in 2011
- Limited Site Investigation conducted in January 2012
- KDHE accepted Cross into VCPRP in March 2012
- Site was delineated during 2012
- Expensive proposed remedy (excavation and offsite disposal)



Remediation Project Partnership

CROSS MANUFACTURING FACILITY – LEWIS, KS



WORLD RECOGNIZED EXPERTISE LEVERAGED AT THE LOCAL LEVEL

World Recognized Expertise Leveraged at the Local Level
Expertise reconnue mondialement déployée à l'échelle locale
Maailmaanlaajutuksen avostettua osaamista vahvasti paikallisesti
Weltweit anerkanntes Fachwissen für Erfolge vor Ort

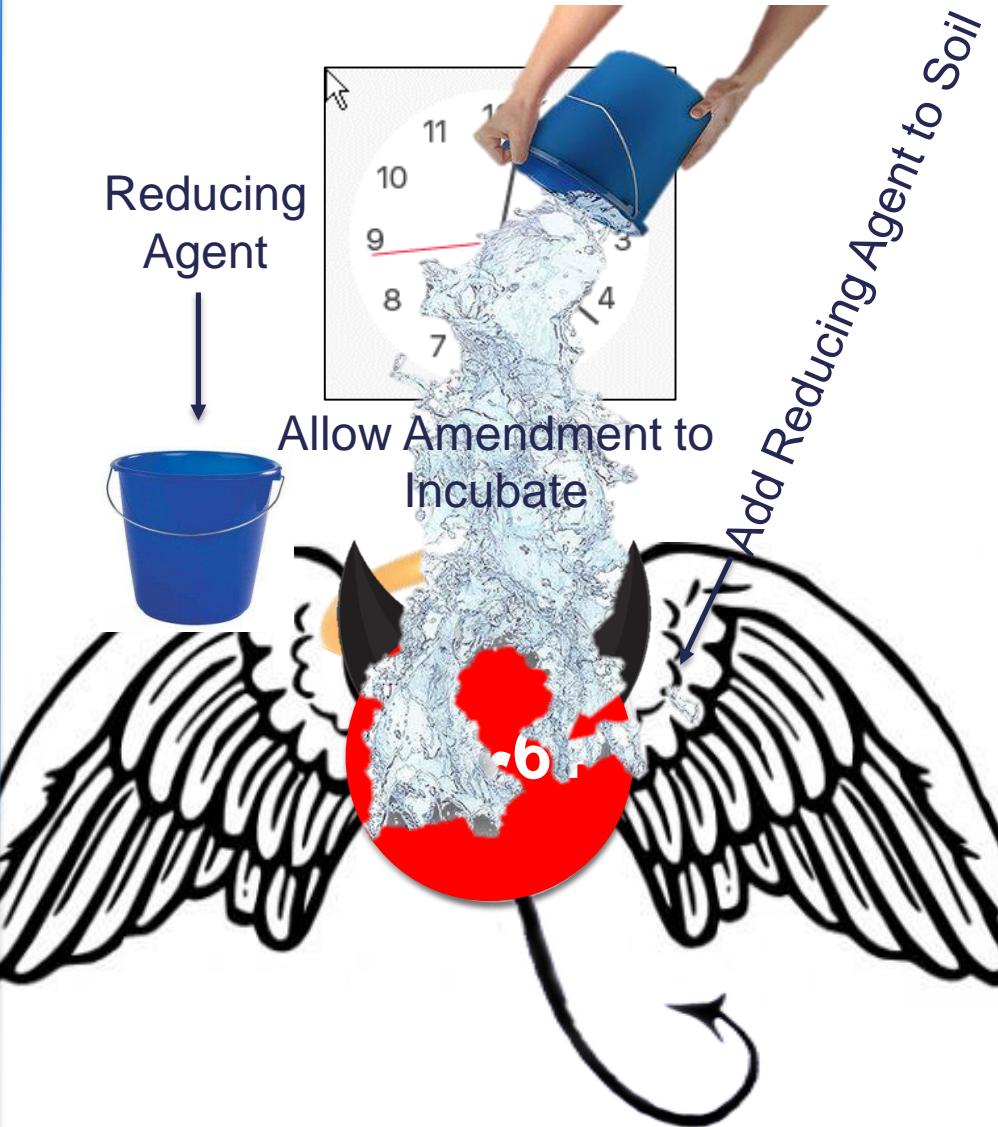
因地制宜提供世界级的专业服务
Globálne uznáne dosviadčenie, wykorzystane na
pozíomе локальнym
Expertiza recunoscută la nivel global aplicată local
세계적 전문기술로 지역화

Globalt erkänd expertis tillämpad lokalt
因地制宜提供世界級的專業服務
ໃບກໍໄປຢູ່ງໆທີ່ມີຄວາມຮັດຮາກໃນກະບົນລື້ອນ
Mundo reconocida experiencia aprovechada a nivel local

Verden anerkendt eksperitse gearret på lokal plan
Verden anerkjente ekspertise utnyttet på lokal nivå
Yerel düzeyde kaliteli dünya tanınan uzmanlık
خلية معترف بها العالم الإشتراكية على المستوى المحلي

Cleanup Concept

CROSS MANUFACTURING FACILITY – LEWIS, KS



Precept

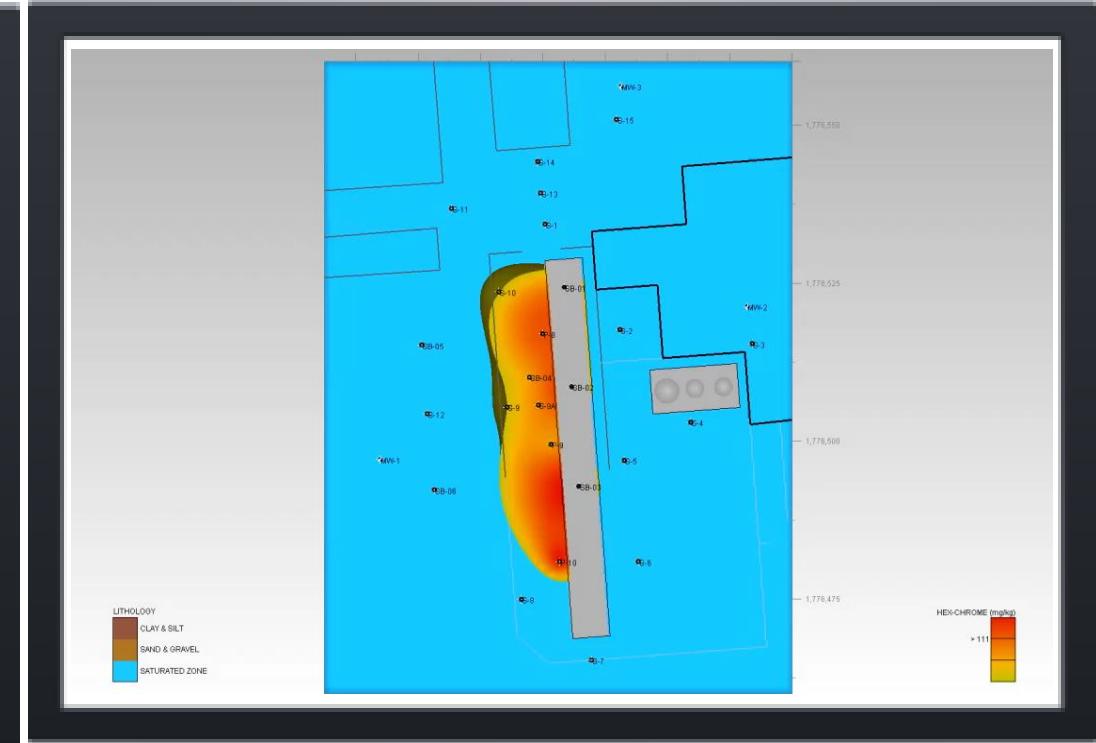
- Chromium affected area \approx 1,000 sf;
Depth \approx 40 ft-bgs
- Can't dig + haul in active facility
- KDHE Tier 2 Standard (111 mg/kg) for Total chromium
- Don't make the problem worse
→ groundwater at 50 ft-bgs not impacted

Alternate Treatment Technique

- Two valence states (Cr^{6+} & Cr^{3+})
 $\text{Total Chromium} = \text{Cr}^{6+} + \text{Cr}^{3+}$
- Valence states have different levels of toxicity
- No Tier 2 Standard for Cr^{6+} and Cr^{3+} published
→ can we calculate a Tier 2 RSK standard????
Yes! Cr^{3+} standard = 3,060,000 mg/kg
- Cr^{6+} standard = 111 mg/kg
- Cr^{6+} will reduce to Cr^{3+} when in contact with reducing agent

Implementation Activities

CROSS MANUFACTURING FACILITY – LEWIS, KS



PM Checklist

- Review delineation data
- Identify area of uncertainty
- Collect pre-design samples
- Collect bench scale samples
- Create CSM
- VCP



Bench Study

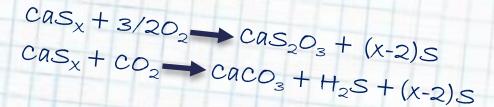
CROSS MANUFACTURING FACILITY – LEWIS, KS



CROSS MANUFACTURING

Reduction of Cr⁶⁺

- Confirm amendment efficacy using site soil
- Calculate amendment dose
- Confirm stability across varying conditions
- Check for offgassing

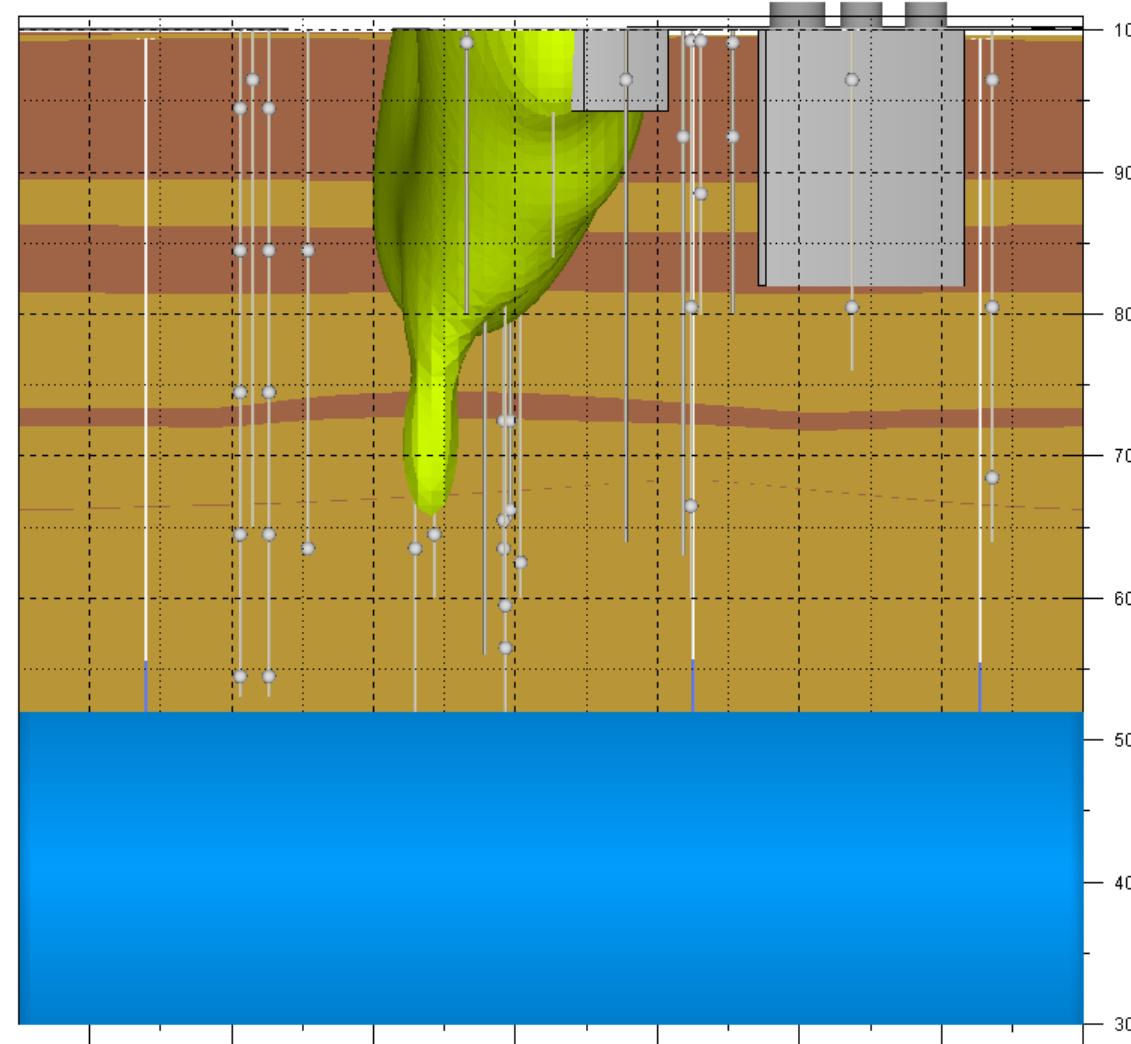


Remedial Approach

CROSS MANUFACTURING FACILITY – LEWIS, KS

Remedial Approach

- Mix batches of amendment
- Install horizontal barrier via direct injection
- Construct infiltration galleries and vent system
- Add amendment via infiltration galleries
- Collect post-treatment confirmation samples

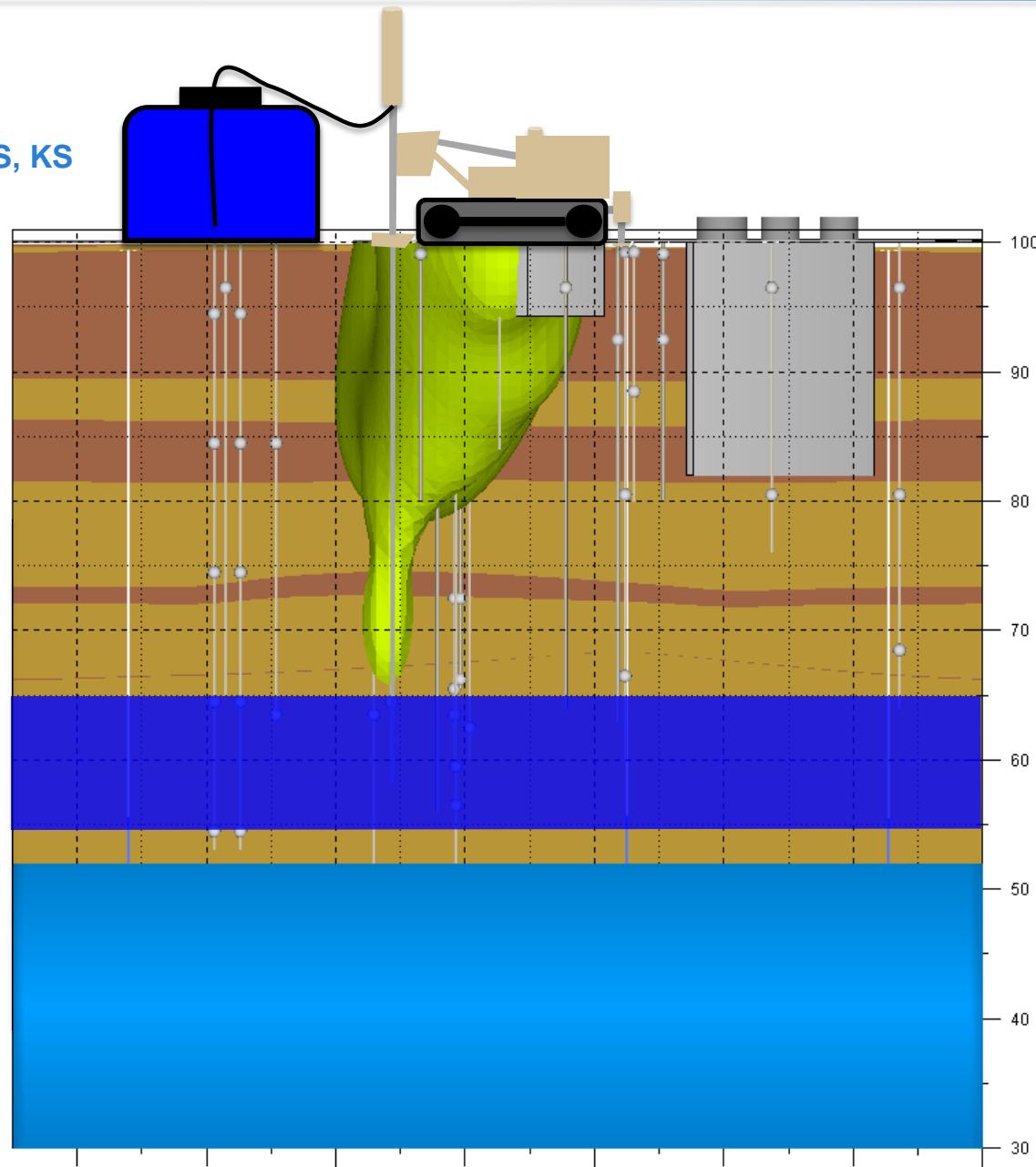


Remedial Approach

CROSS MANUFACTURING FACILITY – LEWIS, KS

Remedial Approach

- Mix batches of amendment
- Install horizontal barrier via direct injection
- Construct infiltration galleries and vent system
- Add amendment via infiltration galleries
- Collect post-treatment confirmation samples

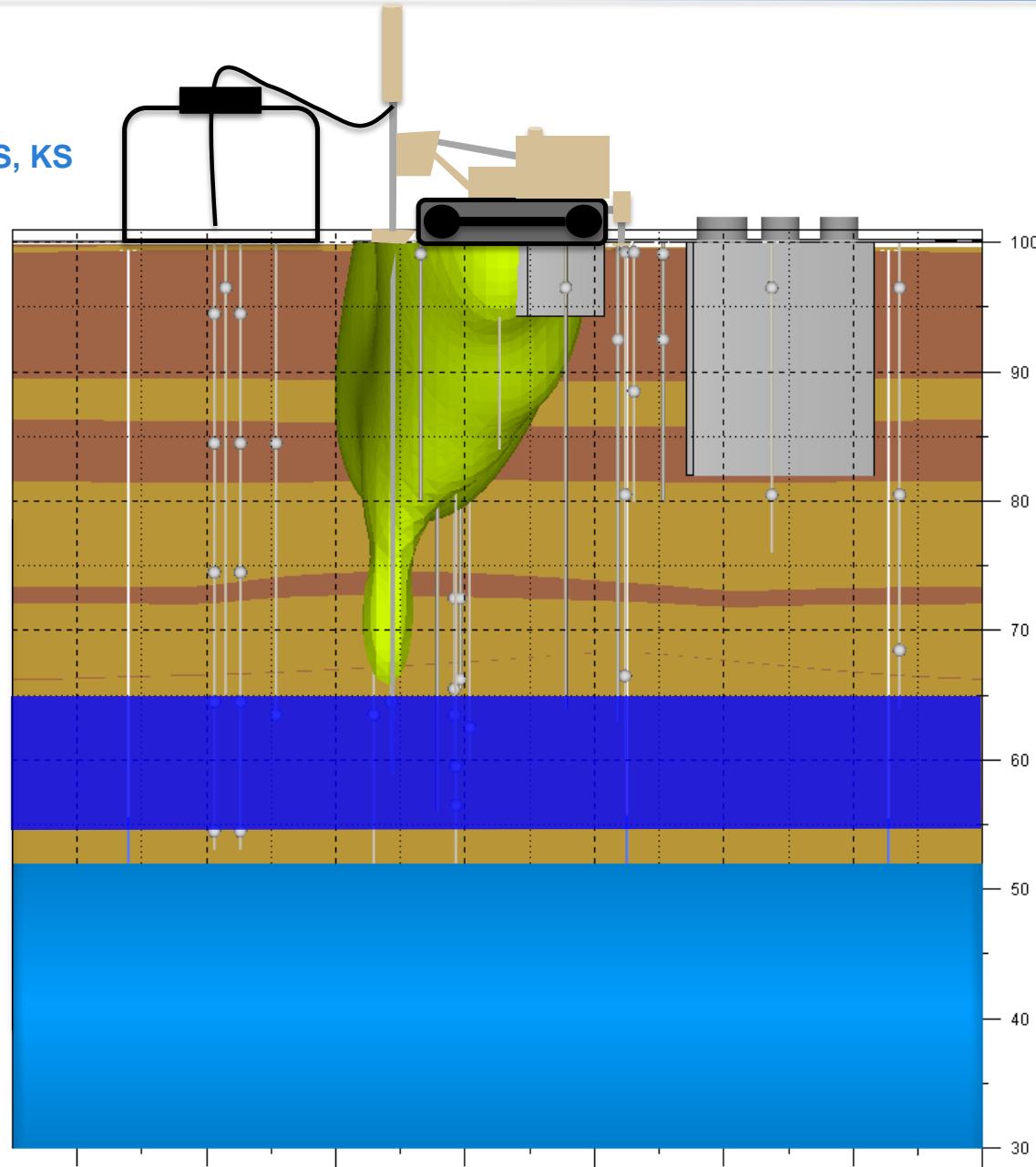


Remedial Approach

CROSS MANUFACTURING FACILITY – LEWIS, KS

Remedial Approach

- Mix batches of amendment
- Install horizontal barrier via direct injection
- Construct infiltration galleries and vent system
- Add amendment via infiltration galleries
- Collect post-treatment confirmation samples

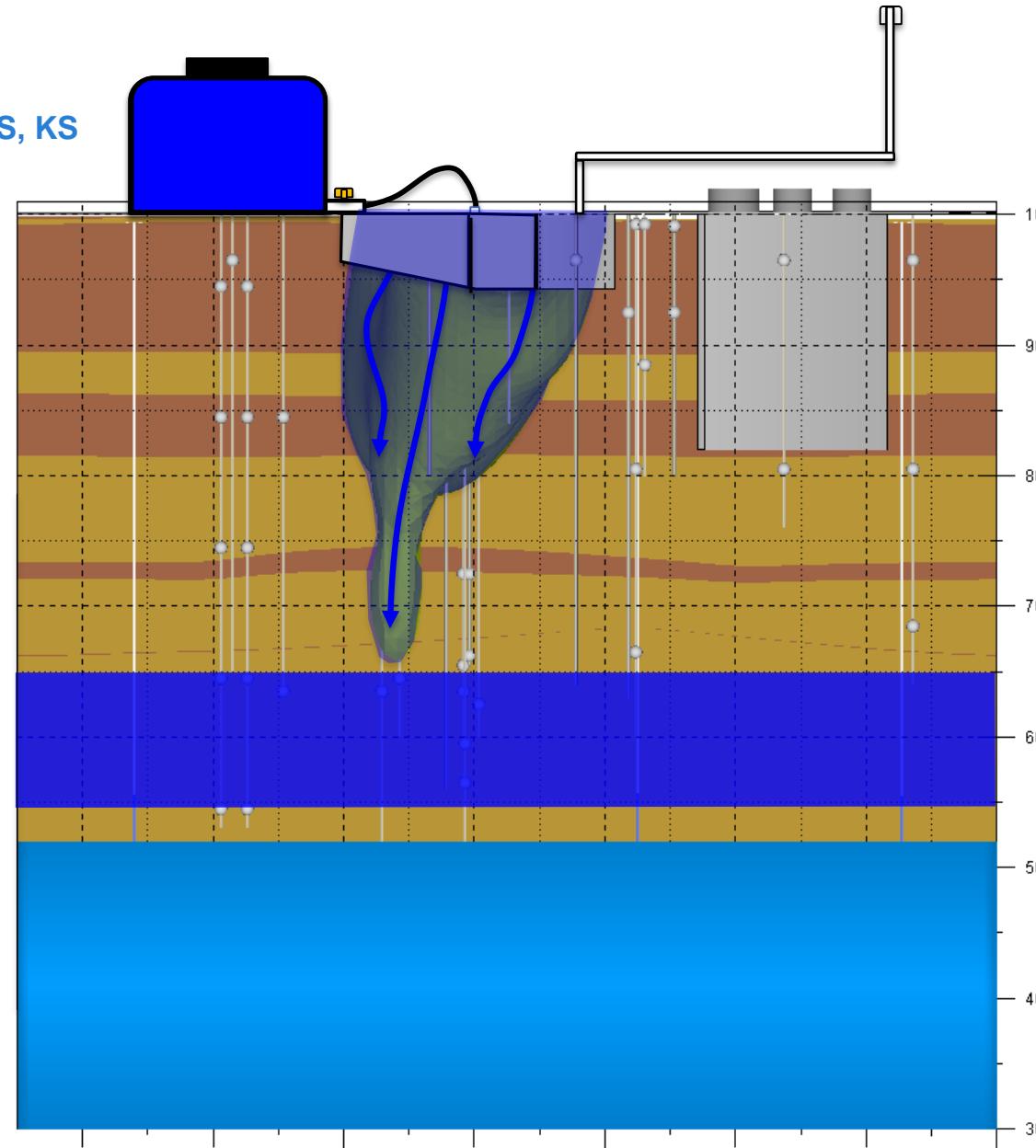


Remedial Approach

CROSS MANUFACTURING FACILITY – LEWIS, KS

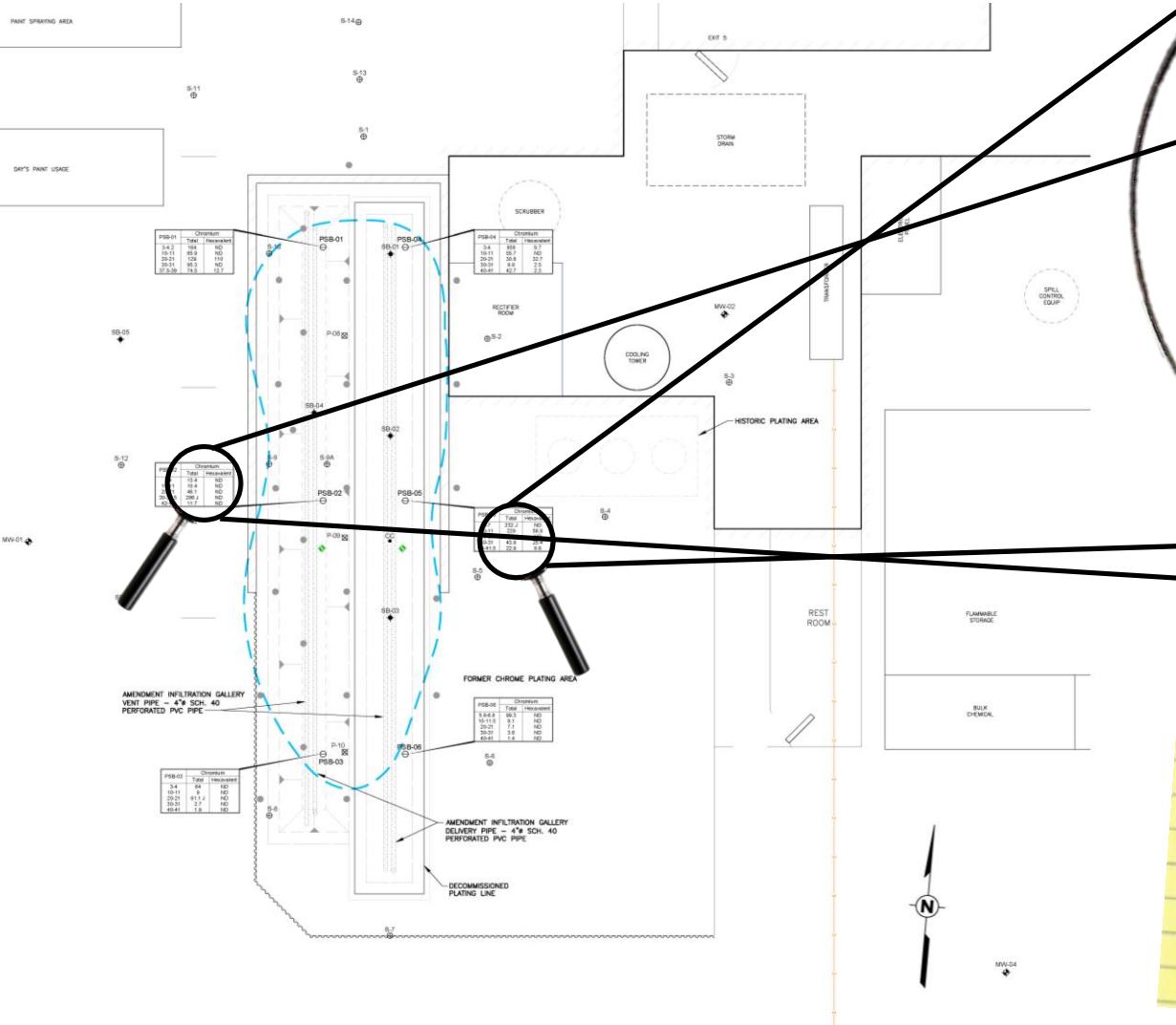
Remedial Approach

- Mix batches of amendment
- Install horizontal barrier via direct injection
- Construct infiltration galleries and vent system
- Add amendment via infiltration galleries
- Collect post-treatment confirmation samples



Confirmation Sampling Results

CROSS MANUFACTURING FACILITY – LEWIS, KS



VCP Results

- 30 soil samples collected in performance soil borings
- Analyzed for Total Cr and Cr⁶⁺
- 21/30 Cr⁶⁺ = ND

Tier 2 non-residential standards achieved in all samples

EUC limited to footprint of affected area (not entire site)

- Post-Treatment GW samples collected from all wells

Groundwater not impacted

Conclusions: Sustainability Analysis

CROSS MANUFACTURING FACILITY – LEWIS, KS

EPA's Spreadsheets for Environmental Footprint Analysis (SEFA) Comparison of In Situ Remediation and Excavation of Chromium-Affected Soils

Component	Metric	Unit of Measure	Footprint by Scenario		Efficiency Gain of In Situ Hexavalent Chromium Remediation
			Excavation & Offsite Disposal of Chromium-Affected Soils	In Situ Reduction & Fixation of Hexavalent Chromium	
Refined materials used on-site	Tons	0.0	0.0	-	
% of refined materials from recycled or reused material	%				
Unrefined materials used on-site	Tons	0.0	0.0	-	
% of unrefined materials from recycled or reused material	%				
On-site hazardous waste disposed of off-site	Tons	520.0	21.0	96%	
On-site non-hazardous waste disposed of off-site	Tons	245.0	29.0		
% of total potential waste recycled or reused	%				
e) Public water use	MG	0.014	0.012		
Total energy used (on-site and off-Site)	MMBtu	1,658.4	837.7		
Energy voluntarily derived from renewable resources					
On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0		
Voluntary purchase of renewable electricity	MWh	0.0	0.0		
Voluntary purchase of RECs	MWh	0.0	0.0		
On-site grid electricity use	MWh	0.0	0.0		
On-site NOx, SOx, and PM emissions	Pounds	736.6	62.3		
On-site HAP emissions	Pounds	0.0	0.0		
Total NOx, SOx, and PM emissions	Pounds	2,403.9	952.9		
Total NOx emissions	Pounds	1,792.1	524.5		
Total SOx emissions	Pounds	367.9	272.6		
Total PM emissions	Pounds	339.2	60.4		
Total HAP emissions	Pounds	8.7	2.3		
Total greenhouse gas emissions	Tons CO ₂ e*	134.7	36.0		

SEFA Analysis

Dig & Haul

In Situ Treatment

- Cost ≈ \$4M
- Generate >500 tons of hazardous waste material (~50 truck loads)
- 500 miles to haz-landfill
- 50 miles to non-haz landfill
- Water used for dust suppression
- 2 site visits
- permanent well points

- Cost ≈ \$500K
- Generate <22 tons of hazardous waste (about 2 truck loads)
- 500 miles to haz-landfill
- 50 miles to non-haz landfill
- 5 site visits (application, monitoring (3X), decommissioning)
- Use about 15,000 gallons potable water
- A single pump powered by diesel generator would be used for 40 hours per application.
- temporary wells

Minimal Offsite Disposal; Cuts HAP & CO₂ emissions in half
Saves \$\$\$



Conclusions

CROSS MANUFACTURING FACILITY – LEWIS, KS

- January 20, 2016 KDHE approved VCP
- April 25, 2016 KDHE approved of No Further Action
- May 11, 2016 KDHE filed termination letter releasing Cross from VCPRP



Acknowledgements

CROSS MANUFACTURING FACILITY – LEWIS, KS

Contact Us:

Matt Burns
WSP | Parsons Brinckerhoff
Woburn, MA
Matt.Burns@WSPGroup.com
781.933.7340

Butch Holum
Remediation Services, Inc.
Independence, KS
bholum@rsi-ks.com
620.331.1200

